UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
230 SOUTH DEARBORN ST.
CHICAGO, ILLINOIS 60604

18 DEC 1990

Honorable John Glenn
United States Senate
Washington, D.C. 20510

REPLY TO ATTENTION OF: 5RA-14

Dear Senator Glenn:

Thank you for your staff's participation in the November 28, 1990, conference call regarding the design investigations proposed for the Industrial Excess Landfill Site (IEL) in Uniontown, Ohio. The United States Environmental Protection Agency (U.S. EPA) understands and shares your concern regarding the IEL site's actual and potential impact on public health and the environment. U.S. EPA is committed to properly designing and implementing the IEL remedy, and it is our intention to collect the necessary information to meet that commitment. As you are aware, U.S. EPA established the IEL Technical Information Committee (TIC) in order to solicit as much technical expertise as possible. We are pleased to report that the IEL TIC has been very useful as a forum for the exchange of technical information, and TIC comments have resulted in positive changes to the design investigation. We welcome the continued participation of the community, government agencies, and elected officials in the IEL TIC.

During the conference call, Bob Alvarez of your staff asked several questions regarding U.S. EPA's sampling strategy for radiochemical analyses. Mr. Alvarez expressed concern with respect to the adequacy of U.S. EPA's approach to the radiation testing and requested additional rationale supporting our approach. In the attachments to this letter, we have provided detailed responses to these requests.

For the radiation survey of IEL, U.S. EPA has chosen to rely on the method of sampling groundwater and landfill leachate, with comprehensive radionuclide analysis. Mr. Alvarez requested justification of EPA's reasoning for not characterizing the waste material by soil core sampling with analysis for radionuclides. Attachment 1 illustrates the statistical probabilities for locating radioactive wastes based on the number of boreholes and samples to be taken. EPA is proposing to perform six intrusive boreholes into the landfill. The intent of this is not for waste characterization but rather to determine the depth of the waste within the landfill, the depth of the water table, to characterize the hydrogeology of the unconsolidated sediments, and to determine the concentration of any contaminants found

yellow

within the landfill.

As can be seen in Attachment 1, if it is assumed that a volume of 10 cubic yards of radioactive waste is present within the 30 acre landfill (refer to Attachment 2 for potential radiological contaminants and estimated volumes), the probability of locating the radioactive waste for the first time with 50,000 boreholes is only 22%. The risk to on-site health and safety from intrusive drilling, the associated schedule delays, and the cost of this enormous sampling and analysis effort are significant barriers to comprehensive waste characterization.

If radioactive contaminants are contained within the landfill, based upon Nuclear Regulatory Commission license information and CERCLA 104(e) information responses, the possible volumes would range from 1 cubic foot to 10 cubic yards, and consist exclusively of intact or ruptured sealed sources of the isotopes listed in Attachment 2. The usual method by which such sources would be located is through drilling a gridded pattern of boreholes followed by logging the boreholes with a highly sensitive gamma probe such as a large sodium iodide crystal. The borehole spacing would be dictated by the effective radius that the probe could "see" the source above background without being completely shielded by surrounding soil. This distance is computed to be in the range 3-4 feet for an unshielded radium needle or 1000 millicurie cesium source as listed above, however, it would drop to less than 1.5 feet for the same source still in its shielded container. For a 30 acre site, location of an unshielded radium or cesium source by gamma logging (with 78%) probability) would take a five foot grid spacing or approximately 52,000 boreholes. For the same source in its shield, a three foot grid spacing would require 145,000 boreholes. On a ten foot grid (13,000 boreholes) there would be only 28% probability of seeing an actual unshielded radium or cesium source, and only 7.5% probability of seeing the same source if still in its shield. The probability of location of an unshielded radium or cesium source with a single gamma logged borehole is on the order of 20 chances in a million under ideal conditions. The likelihood of location of the lower energy gamma and beta sources by gamma logging would be much lower. EPA thus concludes that this approach is impractical.

In response to another concern raised by Mr. Alvarez, regarding EPA's confidence level in using groundwater monitoring results to analyze for radionuclides, the Agency is in the process of performing its statistical analysis of the probability of detecting radionuclides via groundwater monitoring. This statistical analysis is extremely detailed, and we expect to complete it by mid-January, at which time EPA will convey the results under a separate cover.

Another concern raised by Mr. Alvarez was with respect to EPA's proposed approach to sample soil gas to analyze for radon concentrations. As discussed in the conference call of November 28th, EPA intends to modify its sampling protocol in order to measure the average radon influent to the Methane Venting System (MVS) over time, and to use this measured source term in its Clean Air Act compliance tool, AIRDOS-EPA to model impact to nearby residents. Please refer to Attachment 3 for a complete discussion of the presence of radon with respect to the Methane Venting System.

EPA believes that the extensive groundwater and soil gas testing that is being conducted at IEL will identify any problems that exist. Once again, EPA emphasizes that its design investigation has been developed as a "phased approach". If the initial rounds of sampling identify elevated levels of either radiological materials or toxic contaminants in any environmental pathway, EPA will re-evaluate the need for more extensive rounds of testing.

Once again, U.S. EPA extends its appreciation to you and your staff for its involvement in the TIC process. The Agency hopes that the enclosed materials, as well as the summary of research in progress, provides the requested justification of our confidence in the proposed sampling approach for the remedial design studies for IEL. EPA expresses its willingness to participate in a conference call to address any questions that may arise as a result of reviewing the enclosed materials. As always, EPA is willing to meet with representatives of your office as well as Senator Metzenbaum's office to discuss in greater detail any aspect of the remediation at IEL. Please feel free to contact me if you have any questions.

Sincerely yours,

/s/ original signed by
Valdas V. Adamkus

Valdas V. Adamkus
Regional Administrator

18 DEC 1990

Attachments

cc: Hon. Metzenbaum w/attachments

ATTACHMENT 1

MEMO

To: Linda Kern, Region 5 EPA
Jim Benetti, EPA
Ken Brown, EPA\EMSL, Las Vegas

From: AK Singh, UNLV\ERC, Las Vegas AKS

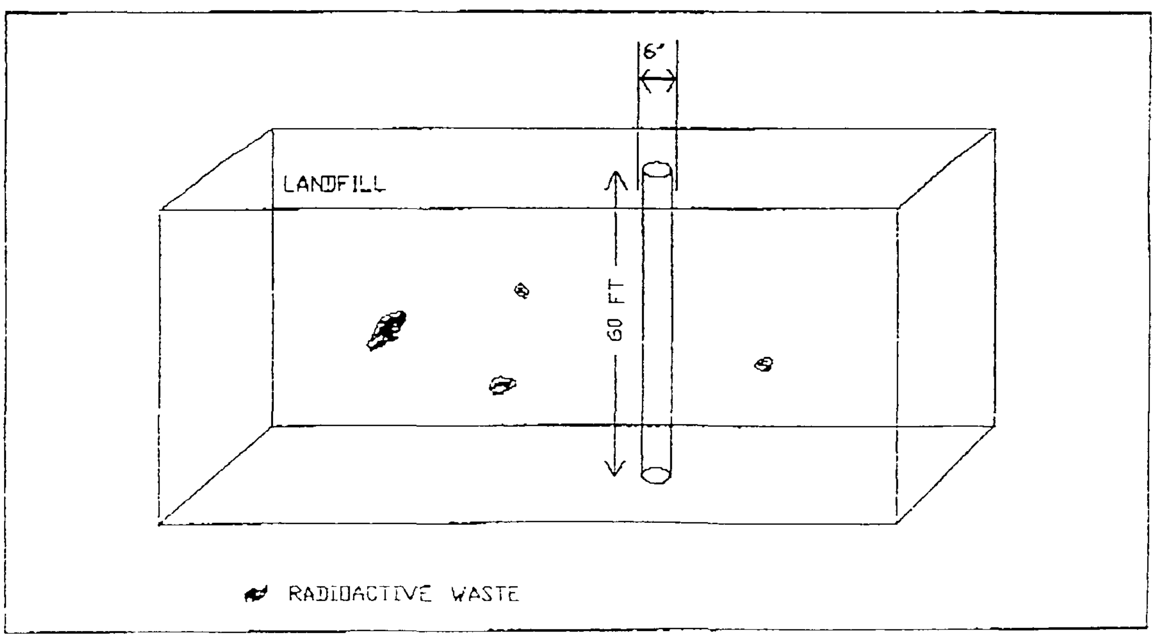
Date: December 3, 1990

Subject: Probability computations for soil sampling at the IEL site in Uniontown, OH

With reference to my memo of Nov. 30, '90, here are the results of my computations on the first problem, related to soil sampling. The problem is described below for the sake of completeness:

Assume that a volume V of radioactive waste is buried in the IEL site of total volume 2,000,000 cubic yds., and also that no information is available about the location of the radioactive waste in the landfill. Compute the probability of hitting the radioactive waste for the first time as a function of number of boreholes N (of size 6" diameter, 60 ft. depth - all of the soil from borehole to be analyzed). Computations are to be done for 3 different scenarios: (a) V = 1 cu ft = 1/27 cu yd (b) V = 1 cu yd., and (c) V = 10 cu yds.

Figure 1 (NOT drawn to scale) : Borehole in a landfill with radioactive waste



TOTAL LANDFILL VOLUME = 2,000,000 cu yds

Total radioactive waste volume = V cu yds

I am making the following assumptions for my computations:

(i) Radioactive waste is randomly distributed in the landfill.

(ii) Borehole locations are chosen independently from each other.

(iii) The analytical method used in soil sampling does not give false positives or false negatives.

Let X = number of boreholes in order to detect radioactivity for the first time

p = V/Total landfill volume = V/2000000

It is known (Hines & Montgomery, 1990 : Probability and Statistics in Engineering and Management Science, 3rd ed., John Wiley, pp. 159-161.) that, under the above assumptions, the distribution of the random variable X can be approximated by the geometric distribution:

$P(X = n) = (1-p)^{n-1} p, \; n = 1, 2, \ldots$

The cumulative distribution function is given by

$P(X \leq n) = P(X = 1) + P(X = 2) + \ldots + P(X = n).$

The input data is summarized below:

Total volume of the landfill = 2000000 cu yds

Borehole dimension = 6" diameter, 60 ft depth (all of the soil from borehole to be analyzed)

V = Volume of radioactive waste in the landfill.

RESULTS OF PROBABILITY COMPUTATIONS

(1) Since the volume of soil from a borehole equals 0.4363 cu yd, exhaustive sampling would take 4583662 boreholes, i.e., it would take 4583662 boreholes for sampling the entire landfill.

(2) Table 1 gives the cumulative probability distribution of number of boreholes needed to first hit radioactive soil for the three values of V suggested by Region 5 EPA.

Table 1 : P(Number of boreholes to hit radioactive waste for the first time ≤ n) = P(X ≤ n)

n	V = 1 cu ft	V = 1 cu yd	V = 10 cu yd
5	0.00000011	0.0000030	0.000030
6	0.00000013	0.0000035	0.000035
7	0.00000015	0.0000040	0.000040
8	0.00000017	0.0000045	0.000045
9	0.00000019	0.0000050	0.000050
10	0.00000020	0.0000055	0.000055
10000	0.0002	0.005	0.05
50000	0.001	0.025	0.22
MEAN	54000000	2000000	200000

The last row of the table gives the average number of boreholes recuired to hit radioactive waste for the first time. For example, if the total volume of radioactive waste present in the landfill is 10 cu yds., then on the average, it would take 200,000 boreholes to hit the radioactive waste for the first time.

The other rows in the table show the cumulative distribution function of the number of boreholes in order to hit the radioactive waste for the first time. For example, if V = 1 cu ft, then the probability that it would take less than or equal to 10 boreholes to hit the radioactivity waste for the first time equals 0.0000002. Even with V = 10 cu yds., the probability of hitting the radioactive waste for the first time in less than or equal to 50,000 boreholes is only 0.22.

It is clear from Table 1 that if the total volume of radioactive waste is ≤ 10 cu yds, then samples of very large sizes have very small probabilities of detecting it.

ATTACHMENT 2

POTENTIAL RADIOLOGICAL CONTAMINANTS AND ESTIMATED VOLUMES

The period of active use of the landfill (1966-1980) is within the timeframe during which all private users of radioactive materials in the U. S. were subject to the regulations of the Nuclear Regulatory Commission or those of its predecessor, the Atomic Energy Commission. Review of current USNRC materials licenses for the potentially responsible parties (PRPs) indicates that all of the tire manufacturers have been licensed to possess sealed source materials in relatively small quantities for use in industrial density gauges, and that these companies are not licensed to possess other (unsealed) materials. (A search of archived materials licenses has been requested of USNRC Region III, but may take several months to complete. There appears to be no reason to believe that these companies would have been previously licensed to possess other than sealed sources used in manufacturing gauges.) Based upon current license information, the maximum quantities of various listed isotopes per sealed source are displayed below.

In addition, a request for information under CERCLA 104(e) authority was made this summer to a number of military organizations and two hospitals known to have used the landfill, and alleged to have disposed of radioactive materials. This information was sent to Mr. Alvarez in August of 1990. The responses that were received indicated possession of very small sealed sources (check sources), several large radiographic units (which were returned to their licensed owner), a quantity of monazite ore (containing thorium) which was exported to Holland under AEC licensed transaction, (contamination associated with its storage was disposed of at Maxey Flats, Kentucky), and references by two Akron hospitals to possession of NRC licensed materials (short lived nuclear medicine isotopes and small implant sealed sources) and state licensed materials. State of Ohio Department of Health records indicate that one of the two hospitals has been licensed by the state to possess radium 226 in sealed sources (radium needles). Of the state and federal licensed medical sources only the radium needles (and possibly the iridium 192 implants) are deemed significant from a the point of view of unauthorized disposal since all other isotopes used in Nuclear Medicine, (radioiodines, technetium, etc.), are selected intentionally to have short half lives (to minimize patient dose), and would have decayed to background shortly after the closing of the landfill.

TABLE 1: POSSIBLE ISOTOPES PRESENT AS SEALED SOURCES AT IEL

ISOTOPE	HALF LIFE	MILLICURIES/SOURCE (MAXIMUM)
Americium 241	432 years	500
Strontium 90	29 years	50
Cesium 137	30.2 years	1000
Iodine 125	59.9 days	500
Gold 198	2.7 days	40
Iridium 192	73 days	40
Krypton 85	10.7 years	2000
Cobalt 60	5.27 years	100
Nickel 63	100 years	15
Iron 55	2.68 years	20
Carbon 14	5730 years	5
Tritium (H-3)	12.3 years	300
Radium 226	1620 years	50

USEPA is currently in the process of evaluating the potential for public impact from the long term presence of these sealed sources in the remediated IEL, assuming eventual deterioration and complete dispersal of the source. This has been requested of U.S. EPA Montgomery Laboratory using the PRESTO computer model, a USEPA developed and authorized code for modeling long term impacts associated with Low Level Radioactive Waste sites. Based upon the results of this modeling, which should be available within four weeks, we should be able to identify sources of concern, for which a rigorous historical accountability can be initiated.

Based upon regulatory records, and upon the existence of a regulatory framework for radioactive materials during the entire period of operation of the landfill, USEPA assumes that radioactive materials, other than natural background may only be present in the form of small intact or ruptured sealed sources as listed above. The total volume of radioactive materials is thus likely to be very small, lying in the range of one cubic foot for intact sources, up to a maximum of ten cubic yards for ruptured sources. (Manufacturers specifications are available for the sealed sources in question and indicate that the actual radionuclides are usually fused within a ceramic matrix, and then sealed inside a welded stainless steel capsule, which is in turn placed in a source holder and source housing - the mobility of a ruptured source of this type would thus be extremely low.) The fact that radioactive waste volume if any is very small is of the utmost significance in design of a survey.

ATTACHMENT 3

THE PRESENCE OF RADON 222 IN GAS SAMPLED IN THE METHANE VENTING SYSTEM

The value of 516 picocuries per liter which was measured in 1989 by the Environmental Response Team is felt to lie within the range of normal background values for soil gas. USEPA's Radon Reference Manual, (EPA 520/1-87-20, page 3-5) notes a typical range of radon in soil gas of 200-1000 picocuries per liter associated with the U.S. average soil radium 226 concentration of 1 picocurie per gram. Mr. Allan Tanner, who recently retired from the U.S. Geological Survey, and is regarded as a world class expert on soil gas radon feels that the value of 516 picocuries per liter is significantly lower than the expected average for Northeast Ohio. Region V has requested several authorities to make available any soil gas radon data which has been measured in the Northeast Ohio area, and is recommending that soil gas radon be measured in locations distant enough from IEL to be considered background, as part of the remedial design sampling plan.

The concern over discharge of radon at levels of over 500 picocuries per liter, in the exhaust of the methane venting system is valid, and warrants an assessment of potential impacts on the public. As discussed in the phone conference call of November 28, 1990, USEPA intends to modify its sampling protocol in order to measure the average radon influent to the MVS over time, and to use this measured source term in its Clean Air Act compliance tool, AIRDOS-EPA to model impacts to nearby residents. In response to the general public concern evidenced in the phone conference, Region V has requested the Office of Radiation Programs - Las Vegas Laboratory to run the AIRDOS program using a radon effluent of 516 picocuries per liter (0.47 Curies per year) from the MVS operating at peak capacity. The program was run using 1986 Akron, Ohio meteorology, with the locations of nearby residents identified from aerial photographs. The output of the program is included as Attachment 4 and indicates that the overall impact under these conditions would be to raise the average ambient level of radon by 0.000224 picocuries per liter at the location of the most exposed individual. This number is very small with respect to the average indoor radon level (1-2 picocuries per liter for the U. S.), and corresponds to a lifetime risk of 8.41 chances in ten million, (compared to 7 chances in one thousand for average indoor exposure due to natural background). The reason that this reduction from 516 to 0.000224 picocuries per liter occurs is from dilution in the atmosphere over the 150 meter distance to the nearest residence. Since this dilution is a linear function of initial radon concentration, it would seem to suggest that soil gas concentrations of 10 or even 100 times the measured value would have little significance compared to natural background.

SYNOPSIS REPORT - CAP-88 (1.00)

ID Code: EXPERMNT_IELFILL1 Date/Time: THR 29 November, 1990 7:53:49 PM

Facility: IELFILL1
Address: ADDRESS
City: CITY
State: Zipcode:

Source Category: EXPERMNT Source Term: 1936

Comments:
PREPAR FOR IELFILL1

RN-222 EXPOSURE AND RISK FOR THE INDIVIDUAL AT MAXIMUM RISK

Location to the individual: 150 METERS NORTHEAST

Exposure in Working Levels: 5.98E-07
pCi/liter at that location: 2.24E-04
Lifetime Fatal Cancer Risk: 8.41E-07

SOURCE TERM (1986)

Nuclide	Class	Amad	Stack #1 Ci/yr	TOTAL
Rn-222	*	0.00	4.70E-01	4.70E-01

ATTACHMENT 4

DISTANCES USED FOR MAXIMUM INDIVIDUAL ASSESSMENT

150 183 300 545

REFERENCE FILE NAMES FOR ASSESSMENT

```
JCL FILE     ===> CAAR.CAA88.EXPERMNT(IELFILL1)
ALLRAD FILE  ===> CBNRACS.CAA88.DATA(ALLRAD88)
STAR FILE    ===> CAAR.CAA88.STARLIB(CAK0557)
PRECA FILE   ===> CAAR.AIRDOS.LIB(JOAIND)
RADRISK FILE ===> CBNRACS.CAA88.RADRISK.V8401RBM
```

DAT THU 24 NOVEMBER, 19__ __:__:__ PM

MAIN OPTIONS:

CONCEN AND DOSEN	OPTION(1)=0
CIRCULAR GRID	OPTION(2)=1

CONCEN OPTIONS:

SECTOR-AVERAGED	OPTION(3)=0
BUOYANT PLUME	OPTION(4)=0
FIXED DEPOSITION VELOCITY	OPTION(5)=0
NO PUNCH, CONCEN	OPTION(6)=0
POINT SOURCE	OPTION(7)=0
PRINT CONCEN MAIN TABLE	OPTION(8)=0
NO PRINT CONCEN CHI/Q TABLES	OPTION(9)=1

DOSEN OPTIONS:

INDIVIDUAL ASSESSMENT	LIPO=0
NO PRINT DOSEN TABLES	NNTB=0
NO PUNCH DOSES	NRTB=0
NO PRINT DOSE SUMMARY	NTTB=0
CARTAB FILE ONLY	NSTB=2
RN-222 WORKING LEVELS	NUTB=1
READ ORGAN NAMES	NVTB=1
BUILDUP TIME IN SOIL	TSUBB= 100.0 YEARS T=3.6524E+04 DAYS

GRID DATA:

```
        BOUNDS OF DIRECTION-INDICES     NDL= 1 NDU=16
        BOUNDS OF DISTANCE-INDICES      NRL= 1 NRU= 4

GQSD=  54.5 (M), COMPUTED FROM IDIST( 4)=  545 (M)

IDIST, THE ARRAY OF RADIAL DISTANCES (M)
   150
   183
   300
   545
```

DATE The 24 November, 1990   7:53:49 PM

NUMBER OF SOURCES NUMST=1

NUMBER OF NUCLIDES NNUCS= 1

SOURCE #: 1

HEIGHT	PH=	7.0
DIAMETER	DIA=	1.00
EXIT VELOCITY	VEL=	0.
HEAT RELEASE RATE	QH=	13300.

BUOYANT PLUME OPTION(4)=0

NUCLIDE RELEASE RATE, REL (CI/YR)

1 RN-222 0.4700

DATE THU 29 November, 1990 7:13:5 P

INDEX	NAME	ISOL CLASS	LAMSUR 1/D	UPTAKE F1ING	AMAD MICRONS
1	RN-222	*	5.48E-05	0.00	0.00

INDEX	NAME	SC 1/S	VD M/S	VG M/S	ANLAM 1/D
1	RN-222	0.00E+00	0.00E+00	0.00E+00	1.81E-01

***NOTE: VG SET TO ZERO FOR AIRDCS UNLESS GREATER THAN 1.000E-02

***NOTE: ANLAM SET TO ZERO FOR AIRDCS UNLESS GREATER THAN 1.000E-02

DAT THR 29 November, 1990 7:53:49 PM

FOR EACH STABILITY CLASS

DCAT, HARMONIC AVERAGE WIND SPEEDS (WIND TOWARDS) WIND FREQ.

	A	B	C	D	E	F	G	PERD
N	1.163	1.543	2.900	4.504	3.342	1.396	0.000	0.086
NW	1.323	1.731	2.486	4.315	3.202	1.352	0.000	0.046
NW	1.251	1.691	2.909	3.709	3.130	1.331	0.000	0.061
NW	1.072	2.000	2.781	4.081	3.098	1.425	0.000	0.026
W	1.001	1.781	2.831	3.362	3.166	1.434	0.000	0.038
SW	1.134	2.277	2.984	3.958	3.356	1.493	0.000	0.033
SW	1.154	1.635	3.100	3.474	3.368	1.470	0.000	0.051
SW	1.102	1.779	2.788	3.672	3.456	1.470	0.000	0.034
S	1.202	2.069	2.753	3.744	3.459	1.496	0.000	0.045
SE	1.187	2.292	3.383	4.411	3.344	1.442	0.000	0.045
SE	1.235	1.899	3.165	4.939	3.498	1.402	0.000	0.082
SE	1.208	2.069	3.393	5.386	3.592	1.417	0.000	0.070
E	1.286	1.830	3.144	4.256	3.320	1.462	0.000	0.080
NE	1.252	1.932	3.233	4.731	3.288	1.471	0.000	0.098
NE	1.237	1.754	3.034	4.506	3.326	1.396	0.000	0.126
NE	1.208	1.912	3.444	4.888	3.261	1.388	0.000	0.079

DAV, ARITHMETIC AVERAGE WIND SPEEDS (WIND TOWARDS)

	A	B	C	D	E	F	G
N	1.637	2.428	3.780	5.440	3.579	1.924	0.000
NW	1.843	2.607	3.336	5.338	3.432	1.875	0.000
NW	1.758	2.549	3.630	4.705	3.352	1.852	0.000
NW	1.492	2.849	3.567	4.917	3.315	1.951	0.000
W	1.361	2.689	3.590	4.472	3.392	1.960	0.000
SW	1.594	2.997	3.864	4.926	3.593	2.015	0.000
SW	1.625	2.468	3.870	4.563	3.605	1.994	0.000
SW	1.543	2.698	3.558	4.687	3.691	1.994	0.000
S	1.692	2.941	3.773	4.848	3.693	2.017	0.000
SE	1.672	3.016	4.100	5.548	3.582	1.967	0.000
SE	1.736	2.858	4.048	6.140	3.730	1.928	0.000
SE	1.701	2.942	4.131	6.334	3.814	1.943	0.000
E	1.801	2.702	3.996	5.485	3.557	1.986	0.000
NE	1.759	2.812	4.093	5.933	3.524	1.994	0.000
NE	1.739	2.688	3.895	5.610	3.563	1.922	0.000
NE	1.701	2.841	4.242	5.912	3.496	1.914	0.000

DAT THR 29 November, 1990 7:55:49 PM

FOR EACH STABILITY CLASS

	A	B	C	D	E	F	G

RAW, FREQUENCIES OF STABILITY CLASSES (WIND TOWARDS)

	A	B	C	D	E	F	G
N	6.04E-03	2.46E-02	7.10E-02	5.44E-01	1.59E-01	1.96E-01	0.00E+00
NNW	9.13E-03	4.48E-02	9.43E-02	5.42E-01	1.46E-01	1.65E-01	0.00E+00
NW	6.87E-03	5.12E-02	9.74E-02	4.72E-01	1.51E-01	2.21E-01	0.00E+00
WNW	1.35E-02	5.52E-02	1.10E-01	5.33E-01	1.56E-01	1.32E-01	0.00E+00
W	1.46E-02	5.30E-02	9.89E-02	4.56E-01	1.57E-01	2.21E-01	0.00E+00
WSW	1.38E-02	5.83E-02	9.57E-02	5.47E-01	1.34E-01	1.52E-01	0.00E+00
SW	7.48E-03	5.10E-02	9.80E-02	4.49E-01	1.64E-01	2.30E-01	0.00E+00
SSW	6.22E-03	4.68E-02	1.07E-01	4.64E-01	1.63E-01	2.14E-01	0.00E+00
S	9.92E-03	3.88E-02	8.82E-02	5.06E-01	1.40E-01	2.17E-01	0.00E+00
SSE	9.30E-03	3.23E-02	9.41E-02	6.35E-01	8.77E-02	1.41E-01	0.00E+00
SE	6.81E-03	4.06E-02	8.67E-02	6.80E-01	8.48E-02	1.01E-01	0.00E+00
ESE	4.44E-03	4.11E-02	9.14E-02	7.32E-01	6.23E-02	6.89E-02	0.00E+00
E	3.50E-03	4.69E-02	1.03E-01	6.07E-01	9.41E-02	1.45E-01	0.00E+00
ENE	6.32E-03	4.82E-02	1.18E-01	6.16E-01	8.91E-02	1.23E-01	0.00E+00
NE	6.36E-03	3.96E-02	1.09E-01	5.81E-01	1.19E-01	1.44E-01	0.00E+00
NNE	3.95E-03	3.07E-02	9.09E-02	6.33E-01	1.22E-01	1.20E-01	0.00E+00
TOT	7.06E-03	4.22E-02	9.72E-02	5.79E-01	1.20E-01	1.54E-01	0.00E+00

HEIGHT OF LID
LIDAI= 1000 (M)

RAINFALL RATE
RR= 100.0 (CM/Y)

AVERAGE AIR TEMPERATURE

TA= 10.0 (DEG C) 283.2 (K)

SURFACE ROUGHNESS LENGTH
ZO= 0.010 (M)

HEIGHT OF WIND MEASUREMENTS
Z= 10.0 (M)

AVERAGE WIND SPEED
UBAR= 4.44 (M/S)

VERTICAL TEMPERATURE GRADIENTS: (TG) (K/M)
STABILITY E 0.073
STABILITY F 0.109
STABILITY G 0.146

*DATE THU 29 November, 1990 7:58:49 PM

*LIST OF INPUT DATA FOR NUCLIDE RN-222 *

RADIOACTIVE DECAY CONSTANT (PER DAY)	0.18E+00
ENVIRONMENTAL DECAY CONSTANT--SURFACE (PER DAY)	0.55E-04
ENVIRONMENTAL DECAY CONSTANT--WATER (PER DAY)	0.00E+00
AVERAGE FRACTION OF ANIMAL'S DAILY INTAKE OF NUCLIDE WHICH APPEARS IN EACH L OF MILK (DAYS/L)	0.00E+00
FRACTION OF ANIMAL'S DAILY INTAKE OF NUCLIDE WHICH APPEARS IN EACH KG OF FLESH (DAYS/KG)	0.00E+00
CONCENTRATION FACTOR FOR UPTAKE OF NUCLIDE FROM SOIL FOR PASTURE AND FORAGE (IN PCI/KG DRY WEIGHT PER PCI/KG DRY SOIL)	0.00E+00
CONCENTRATION FACTOR FOR UPTAKE OF NUCLIDE FROM SOIL BY EDIBLE PARTS OF CROPS (IN PCI/KG WET WEIGHT PER PCI/KG DRY SOIL)	0.00E+00
GI UPTAKE FRACTION (INHALATION)	0.00E+00
GI UPTAKE FRACTION (INGESTION)	0.00E+00
PARTICLE SIZE (MICRONS)	0.00E+00
SOLUBILITY CLASS	*

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

AREA: WIND TOWARD	AREA: DISTANCE (METERS)	EXPOSURE LEVEL(.7 EQF) (PERSON .WL)	ADJUSTED EQUIL. FRACT.	ADJUSTED EXPOSURE LEVELS
N	150	9.1E-07	0.27	3.5E-07
N	183	8.2E-07	0.27	3.2E-07
N	300	5.2E-07	0.28	2.1E-07
N	545	2.7E-07	0.29	1.1E-07
NNW	150	5.6E-07	0.27	2.1E-07
NNW	183	5.0E-07	0.27	1.9E-07
NNW	300	3.1E-07	0.28	1.2E-07
NNW	545	1.5E-07	0.29	6.4E-08
NW	150	7.0E-07	0.27	2.7E-07
NW	183	6.3E-07	0.27	2.4E-07
NW	300	4.0E-07	0.28	1.6E-07
NW	545	2.1E-07	0.29	8.8E-08
WNW	150	3.2E-07	0.27	1.2E-07
WNW	183	2.9E-07	0.27	1.1E-07
WNW	300	1.8E-07	0.28	7.1E-08
WNW	545	8.9E-08	0.29	3.7E-08
W	150	4.5E-07	0.27	1.7E-07
[redacted]	[redacted]	4.1E-07	0.27	[redacted]
W	300	2.6E-07	0.28	1.0E-07
W	545	1.4E-07	0.29	5.7E-08
WSW	150	4.1E-07	0.27	1.6E-07
WSW	183	3.7E-07	0.27	1.4E-07
WSW	300	2.3E-07	0.28	9.1E-08
WSW	545	1.1E-07	0.29	4.7E-08
SW	150	5.7E-07	0.27	2.2E-07
SW	183	5.2E-07	0.27	2.0E-07
SW	300	3.3E-07	0.28	1.3E-07
SW	545	1.8E-07	0.29	7.4E-08
SSW	150	3.8E-07	0.27	1.5E-07
SSW	183	3.5E-07	0.27	1.3E-07
SSW	300	2.2E-07	0.28	8.8E-08
SSW	545	1.2E-07	0.29	4.8E-08
S	150	5.2E-07	0.27	2.0E-07
S	183	4.7E-07	0.27	1.8E-07
S	300	3.0E-07	0.28	1.2E-07
S	545	1.6E-07	0.29	6.4E-08
SSE	150	5.7E-07	0.27	2.2E-07
SSE	183	5.0E-07	0.27	2.0E-07
SSE	300	3.1E-07	0.28	1.2E-07
SSE	545	1.4E-07	0.29	6.0E-08
SE	150	1.1E-06	0.27	4.1E-07
SE	183	9.4E-07	0.27	3.6E-07
SE	300	5.5E-07	0.28	2.2E-07
SE	545	2.5E-07	0.29	1.0E-07
ESE	150	9.0E-07	0.27	3.4E-07
ESE	183	7.9E-07	0.27	3.1E-07
ESE	300	4.6E-07	0.28	1.8E-07

ESE	545	2.0E-07	0.29	8.3E-08
E	150	1.0E-06	0.27	4.0E-07
E	183	9.3E-07	0.27	3.6E-07
E	300	5.6E-07	0.28	2.2E-07
E	545	2.6E-07	0.29	1.1E-07
ENE	150	1.3E-06	0.27	4.9E-07
ENE	183	1.1E-06	0.27	4.3E-07
ENE	300	6.6E-07	0.28	2.6E-07
ENE	545	3.0E-07	0.29	1.3E-07
[redacted]	[redacted]	1.6E-06	0.27	[redacted]
NE	183	1.4E-06	0.27	5.4E-07
NE	300	8.4E-07	0.28	3.3E-07
NE	545	4.0E-07	0.29	1.7E-07
NNE	150	9.3E-07	0.27	3.5E-07
NNE	183	8.2E-07	0.27	3.2E-07
NNE	300	5.0E-07	0.28	2.0E-07
NNE	545	2.4E-07	0.29	1.0E-07

DATE THR 2[illegible] November, 19[illegible] [illegible]:57:49 P[illegible]

STAR INPUT, WIND FREQUENCIES (WIND FROM)

CLASS: A

N	2.200E-04	2.300E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	1.200E-04	9.000E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NE	2.000E-04	1.800E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ENE	2.500E-04	2.100E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
E	3.700E-04	1.800E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ESE	2.100E-04	1.400E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SE	1.900E-04	2.300E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SSE	1.700E-04	2.500E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
S	2.700E-04	2.500E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SSW	1.500E-04	1.600E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SW	3.700E-04	4.300E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WSW	2.800E-04	3.400E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	1.200E-04	1.600E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	1.500E-04	1.600E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NW	2.600E-04	3.000E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	2.100E-04	2.100E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00

CLASS: B

N	3.000E-04	8.000E-04	6.600E-04	0.000E+00	0.000E+00	0.000E+00
NNE	3.900E-04	6.900E-04	5.000E-04	0.000E+00	0.000E+00	0.000E+00
NE	7.400E-04	1.260E-03	5.900E-04	0.000E+00	0.000E+00	0.000E+00
ENE	2.300E-04	1.030E-03	6.900E-04	0.000E+00	0.000E+00	0.000E+00
E	4.900E-04	8.900E-04	6.200E-04	0.000E+00	0.000E+00	0.000E+00
ESE	2.600E-04	6.900E-04	4.800E-04	0.000E+00	0.000E+00	0.000E+00
SE	8.400E-04	1.490E-03	8.000E-04	0.000E+00	0.000E+00	0.000E+00
SSE	5.300E-04	9.600E-04	5.700E-04	0.000E+00	0.000E+00	0.000E+00
S	7.000E-04	8.900E-04	5.300E-04	0.000E+00	0.000E+00	0.000E+00
SSW	5.100E-04	1.030E-03	8.700E-04	0.000E+00	0.000E+00	0.000E+00
SW	1.280E-03	2.110E-03	1.600E-03	0.000E+00	0.000E+00	0.000E+00
WSW	9.500E-04	2.200E-03	1.580E-03	0.000E+00	0.000E+00	0.000E+00
W	8.500E-04	1.730E-03	1.120E-03	0.000E+00	0.000E+00	0.000E+00
WNW	4.900E-04	1.300E-03	1.080E-03	0.000E+00	0.000E+00	0.000E+00
NW	7.300E-04	1.350E-03	1.260E-03	0.000E+00	0.000E+00	0.000E+00
NNW	1.700E-04	7.600E-04	5.300E-04	0.000E+00	0.000E+00	0.000E+00

CLASS: C

N	3.600E-04	1.170E-03	2.080E-03	3.900E-04	0.000E+00	0.000E+00
NNE	2.500E-04	1.330E-03	1.880E-03	1.400E-04	0.000E+00	0.000E+00
NE	2.700E-04	1.230E-03	3.130E-03	3.000E-04	0.000E+00	0.000E+00
ENE	2.100E-04	8.700E-04	1.850E-03	2.700E-04	0.000E+00	0.000E+00
E	2.300E-04	1.490E-03	1.750E-03	2.300E-04	0.000E+00	0.000E+00
ESE	2.000E-04	1.080E-03	1.440E-03	1.400E-04	0.000E+00	0.000E+00
SE	3.500E-04	2.060E-03	3.340E-03	2.100E-04	0.000E+00	0.000E+00
SSE	4.500E-04	1.760E-03	2.040E-03	7.000E-05	2.000E-05	0.000E+00
S	4.300E-04	1.810E-03	3.410E-03	4.600E-04	0.000E+00	0.000E+00
SSW	2.800E-04	1.420E-03	4.440E-03	9.800E-04	2.000E-05	0.000E+00
SW	8.000E-04	4.050E-03	7.530E-03	1.300E-03	5.000E-05	0.000E+00
WSW	5.300E-04	3.110E-03	6.380E-03	1.370E-03	1.400E-04	0.000E+00
W	4.200E-04	2.310E-03	4.600E-03	8.500E-04	7.000E-05	0.000E+00
WNW	2.200E-04	1.580E-03	3.820E-03	7.100E-04	5.000E-05	0.000E+00
NW	3.800E-04	1.330E-03	4.030E-03	8.700E-04	2.000E-05	0.000E+00
NNW	1.500E-04	1.030E-03	2.590E-03	4.300E-04	0.000E+00	0.000E+00

DATE THU 29 November, 199[illegible] 7:53:49 PM

STAR INPUT, WIND FREQUENCIES (WIND FROM)

CLASS: D

N	7.900E-04	4.510E-03	9.860E-03	7.230E-03	4.100E-04	1.400E-04
NNE	4.900E-04	3.640E-03	6.640E-03	4.620E-03	2.500E-04	0.000E+00
NE	1.040E-03	4.780E-03	1.107E-02	5.470E-03	4.600E-04	2.000E-05
ENE	4.700E-04	2.930E-03	8.860E-03	5.490E-03	4.800E-04	5.000E-05
E	8.600E-04	4.070E-03	7.830E-03	4.190E-03	2.500E-04	0.000E+00
ESE	2.700E-04	2.080E-03	6.860E-03	4.460E-03	1.400E-04	0.000E+00
SE	9.700E-04	5.510E-03	1.393E-02	8.120E-03	2.700E-04	9.000E-05
SSE	5.100E-04	3.250E-03	1.002E-02	1.007E-02	1.010E-03	5.000E-05
S	7.300E-04	5.130E-03	1.954E-02	1.924E-02	1.970E-03	2.300E-04
SSW	6.700E-04	4.230E-03	1.650E-02	2.398E-02	3.620E-03	7.100E-04
SW	1.270E-03	9.270E-03	2.634E-02	3.059E-02	4.620E-03	1.100E-03
WSW	9.600E-04	6.910E-03	1.888E-02	2.670E-02	5.130E-03	1.850E-03
W	1.210E-03	7.140E-03	1.705E-02	1.940E-02	3.320E-03	4.600E-04
WNW	3.700E-04	3.620E-03	1.311E-02	2.732E-02	5.790E-03	8.700E-04
NW	8.600E-04	4.940E-03	1.675E-02	2.567E-02	6.110E-03	1.580E-03
NNW	4.800E-04	4.320E-03	1.034E-02	1.121E-02	1.490E-03	8.500E-04

CLASS: E

N	0.000E+00	2.400E-03	3.960E-03	0.000E+00	0.000E+00	0.000E+00
NNE	0.000E+00	2.080E-03	3.410E-03	0.000E+00	0.000E+00	0.000E+00
NE	0.000E+00	3.550E-03	4.780E-03	0.000E+00	0.000E+00	0.000E+00
ENE	0.000E+00	1.940E-03	2.540E-03	0.000E+00	0.000E+00	0.000E+00
E	0.000E+00	3.230E-03	2.700E-03	0.000E+00	0.000E+00	0.000E+00
ESE	0.000E+00	2.380E-03	1.670E-03	0.000E+00	0.000E+00	0.000E+00
SE	0.000E+00	5.240E-03	4.000E-03	0.000E+00	0.000E+00	0.000E+00
SSE	0.000E+00	3.500E-03	3.200E-03	0.000E+00	0.000E+00	0.000E+00
S	0.000E+00	6.020E-03	7.640E-03	0.000E+00	0.000E+00	0.000E+00
SSW	0.000E+00	4.670E-03	4.920E-03	0.000E+00	0.000E+00	0.000E+00
SW	0.000E+00	6.750E-03	8.260E-03	0.000E+00	0.000E+00	0.000E+00
WSW	0.000E+00	4.120E-03	4.620E-03	0.000E+00	0.000E+00	0.000E+00
W	0.000E+00	3.410E-03	4.120E-03	0.000E+00	0.000E+00	0.000E+00
WNW	0.000E+00	1.350E-03	3.000E-03	0.000E+00	0.000E+00	0.000E+00
NW	0.000E+00	2.490E-03	4.480E-03	0.000E+00	0.000E+00	0.000E+00
NNW	0.000E+00	1.740E-03	2.220E-03	0.000E+00	0.000E+00	0.000E+00

CLASS: F

N	3.040E-03	6.820E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNE	2.320E-03	4.900E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NE	3.760E-03	7.940E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ENE	1.570E-03	3.500E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
E	2.830E-03	5.490E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
ESE	1.180E-03	2.240E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SE	5.410E-03	8.120E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SSE	2.930E-03	4.640E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
S	6.070E-03	1.078E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SSW	3.440E-03	5.970E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
SW	6.550E-03	1.160E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WSW	3.870E-03	8.190E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
W	3.790E-03	7.850E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
WNW	1.680E-03	3.130E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NW	2.970E-03	5.330E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
NNW	2.140E-03	4.230E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00

DATE THR 29 November, 1990 7:53:49 PM

NOBCT, NUMBER OF BEEF CATTLE

	150	193	300	545
N	4	4	4	4
NNW	4	4	4	4
NW	4	4	4	4
WNW	4	4	4	4
W	4	4	4	4
WSW	4	4	4	4
SW	4	4	4	4
SSW	4	4	4	4
S	4	4	4	4
SSE	4	4	4	4
SE	4	4	4	4
ESE	4	4	4	4
E	4	4	4	4
ENE	4	4	4	4
NE	4	4	4	4
NNE	4	4	4	4

DATE THU 29 November, 1990 7:57:49 P

NCMCT, NUMBER OF MILK CATTLE

	150	193	300	545
N	2	2	2	2
NNW	2	2	2	2
NW	2	2	2	2
WNW	2	2	2	2
W	2	2	2	2
WSW	2	2	2	2
SW	2	2	2	2
SSW	2	2	2	2
S	2	2	2	2
SSE	2	2	2	2
SE	2	2	2	2
ESE	2	2	2	2
E	2	2	2	2
ENE	2	2	2	2
NE	2	2	2	2
NNE	2	2	2	2

DATE THU 29 November, 1990 7:57:49 PM

INTEG. AREA OF VEGETABLE CROP PRODUCTION (M**2)

	150	183	500	545
N	1.00E+04	1.00E+04	1.00E+04	1.00E+04
NNW	1.00E+04	1.00E+04	1.00E+04	1.00E+04
NW	1.00E+04	1.00E+04	1.00E+04	1.00E+04
WNW	1.00E+04	1.00E+04	1.00E+04	1.00E+04
W	1.00E+04	1.00E+04	1.00E+04	1.00E+04
WSW	1.00E+04	1.00E+04	1.00E+04	1.00E+04
SW	1.00E+04	1.00E+04	1.00E+04	1.00E+04
SSW	1.00E+04	1.00E+04	1.00E+04	1.00E+04
S	1.00E+04	1.00E+04	1.00E+04	1.00E+04
SSE	1.00E+04	1.00E+04	1.00E+04	1.00E+04
SE	1.00E+04	1.00E+04	1.00E+04	1.00E+04
ESE	1.00E+04	1.00E+04	1.00E+04	1.00E+04
E	1.00E+04	1.00E+04	1.00E+04	1.00E+04
ENE	1.00E+04	1.00E+04	1.00E+04	1.00E+04
NE	1.00E+04	1.00E+04	1.00E+04	1.00E+04
NNE	1.00E+04	1.00E+04	1.00E+04	1.00E+04

DATE THR 29 November, 1990 7:53:49 PM

INTRA, POPULATION

	150	183	300	545
N	1	1	1	1
NNW	1	1	1	1
NW	1	1	1	1
WNW	1	1	1	1
W	1	1	1	1
WSW	1	1	1	1
SW	1	1	1	1
SSW	1	1	1	1
S	1	1	1	1
SSE	1	1	1	1
SE	1	1	1	1
ESE	1	1	1	1
E	1	1	1	1
ENE	1	1	1	1
NE	1	1	1	1
NNE	1	1	1	1

ESTIMATED RADIONUCLIDE CONCENTRATIONS

WIND TOWARD	DISTANCE (METERS)	NUCLIDE	AIR CONCEN (PCI/L)	DRY DEP RATE (PCI/M2/S)	WET DEP RATE (PCI/M2/S)	GND DEP RATE (PCI/M2/S)
N	150	RN-222	1.3E-04	0.0E+00	0.0E+00	0.0E+00
N	183	RN-222	1.2E-04	0.0E+00	0.0E+00	0.0E+00
N	300	RN-222	7.4E-05	0.0E+00	0.0E+00	0.0E+00
N	545	RN-222	3.9E-05	0.0E+00	0.0E+00	0.0E+00
NNW	150	RN-222	7.9E-05	0.0E+00	0.0E+00	0.0E+00
NNW	183	RN-222	7.1E-05	0.0E+00	0.0E+00	0.0E+00
NNW	300	RN-222	4.4E-05	0.0E+00	0.0E+00	0.0E+00
NNW	545	RN-222	2.2E-05	0.0E+00	0.0E+00	0.0E+00
NW	150	RN-222	9.9E-05	0.0E+00	0.0E+00	0.0E+00
NW	183	RN-222	9.0E-05	0.0E+00	0.0E+00	0.0E+00
NW	300	RN-222	5.7E-05	0.0E+00	0.0E+00	0.0E+00
NW	545	RN-222	3.0E-05	0.0E+00	0.0E+00	0.0E+00
WNW	150	RN-222	4.6E-05	0.0E+00	0.0E+00	0.0E+00
WNW	183	RN-222	4.1E-05	0.0E+00	0.0E+00	0.0E+00
WNW	300	RN-222	2.6E-05	0.0E+00	0.0E+00	0.0E+00
WNW	545	RN-222	1.3E-05	0.0E+00	0.0E+00	0.0E+00
W	150	RN-222	6.4E-05	0.0E+00	0.0E+00	0.0E+00
W	183	RN-222	[redacted]	0.0E+00	0.0E+00	0.0E+00
W	300	RN-222	3.7E-05	0.0E+00	0.0E+00	0.0E+00
W	545	RN-222	2.0E-05	0.0E+00	0.0E+00	0.0E+00
WSW	150	RN-222	5.9E-05	0.0E+00	0.0E+00	0.0E+00
WSW	183	RN-222	5.3E-05	0.0E+00	0.0E+00	0.0E+00
WSW	300	RN-222	3.3E-05	0.0E+00	0.0E+00	0.0E+00
WSW	545	RN-222	1.6E-05	0.0E+00	0.0E+00	0.0E+00
SW	150	RN-222	8.2E-05	0.0E+00	0.0E+00	0.0E+00
SW	183	RN-222	7.4E-05	0.0E+00	0.0E+00	0.0E+00
SW	300	RN-222	4.8E-05	0.0E+00	0.0E+00	0.0E+00
SW	545	RN-222	2.5E-05	0.0E+00	0.0E+00	0.0E+00
SSW	150	RN-222	5.5E-05	0.0E+00	0.0E+00	0.0E+00
SSW	183	RN-222	5.0E-05	0.0E+00	0.0E+00	0.0E+00
SSW	300	RN-222	3.2E-05	0.0E+00	0.0E+00	0.0E+00
SSW	545	RN-222	1.7E-05	0.0E+00	0.0E+00	0.0E+00
S	150	RN-222	7.5E-05	0.0E+00	0.0E+00	0.0E+00
S	183	RN-222	6.8E-05	0.0E+00	0.0E+00	0.0E+00
S	300	RN-222	4.3E-05	0.0E+00	0.0E+00	0.0E+00
S	545	RN-222	2.2E-05	0.0E+00	0.0E+00	0.0E+00
SSE	150	RN-222	6.1E-05	0.0E+00	0.0E+00	0.0E+00
SSE	183	RN-222	7.2E-05	0.0E+00	0.0E+00	0.0E+00
SSE	300	RN-222	4.4E-05	0.0E+00	0.0E+00	0.0E+00
SSE	545	RN-222	2.1E-05	0.0E+00	0.0E+00	0.0E+00
SE	150	RN-222	1.5E-04	0.0E+00	0.0E+00	0.0E+00
SE	183	RN-222	1.3E-04	0.0E+00	0.0E+00	0.0E+00
SE	300	RN-222	7.9E-05	0.0E+00	0.0E+00	0.0E+00
SE	545	RN-222	3.6E-05	0.0E+00	0.0E+00	0.0E+00
ESE	150	RN-222	1.3E-04	0.0E+00	0.0E+00	0.0E+00
ESE	183	RN-222	1.1E-04	0.0E+00	0.0E+00	0.0E+00
ESE	300	RN-222	6.5E-05	0.0E+00	0.0E+00	0.0E+00
ESE	545	RN-222	2.9E-05	0.0E+00	0.0E+00	0.0E+00
E	150	RN-222	1.5E-04	0.0E+00	0.0E+00	0.0E+00
E	183	RN-222	1.3E-04	0.0E+00	0.0E+00	0.0E+00
E	300	RN-222	8.0E-05	0.0E+00	0.0E+00	0.0E+00
E	545	RN-222	3.8E-05	0.0E+00	0.0E+00	0.0E+00
ENE	150	RN-222	1.8E-04	0.0E+00	0.0E+00	0.0E+00

DATE Thu 29 November, 1990 7:53:49 PM

OPTIONS SELECTED FOR DOSE AND INTAKE CALCULATIONS

CALCULATIONS ARE MADE FOR THE MAXIMALLY-EXPOSED INDIVIDUAL.

TABLES FOR EACH NUCLIDE LISTING DOSES BY ORGAN AND PATHWAY AT EACH ENVIRONMENTAL LOCATION ARE OMITTED.

WORKING LEVELS ARE CALCULATED FOR RN-222 IF IT IS IN THE SOURCE TERM.

ORGAN NAMES ARE INPUT.

DATE TH [illegible] November, 19[illegible] [illegible]

VALUES FOR RADIONUCLIDE-INDEPENDENT VARIABLES

NUMBER OF NUCLIDES CONSIDERED	1
TIME DELAY--INGESTION OF PASTURE GRASS BY ANIMALS (HR)	0.00E+00
TIME DELAY--INGESTION OF STORED FEED BY ANIMALS (HR)	0.22E+04
TIME DELAY--INGESTION OF LEAFY VEGETABLES BY MAN (HR)	0.34E+03
TIME DELAY--INGESTION OF PRODUCE BY MAN (HR)	0.34E+03
REMOVAL RATE CONSTANT FOR PHYSICAL LOSS BY WEATHERING (PER HOUR)	0.29E-02
PERIOD OF EXPOSURE DURING GROWING SEASON--PASTURE GRASS (HR)	0.72E+03
PERIOD OF EXPOSURE DURING GROWING SEASON--CROPS OR LEAFY VEGETABLES (HR)	0.14E+04
AGRICULTURAL PRODUCTIVITY BY UNIT AREA (GRASS-COW-MILK-MAN PATHWAY (KG/SQ. METER))	0.28E+00
AGRICULTURAL PRODUCTIVITY BY UNIT AREA (PRODUCE OR LEAFY VEG INGESTED BY MAN (KG/SQ METER))	0.72E+00
FRACTION OF YEAR ANIMALS GRAZE ON PASTURE	0.40E+00
FRACTION OF DAILY FEED THAT IS PASTURE GRASS WHEN ANIMAL GRAZES ON PASTURE	0.43E+00
CONSUMPTION RATE OF CONTAMINATED FEED OR FORAGE BY AN ANIMAL IN KG/DAY (DRY WEIGHT)	0.16E+02
TRANSPORT TIME FROM ANIMAL FEED-MILK-MAN (DAY)	0.20E+01
RATE OF INGESTION OF PRODUCE BY MAN (KG/YR)	0.18E+03
RATE OF INGESTION OF MILK BY MAN (LITERS/YR)	0.11E+03
RATE OF INGESTION OF MEAT BY MAN (KG/YR)	0.85E+02
RATE OF INGESTION OF LEAFY VEGETABLES BY MAN (KG/YR)	0.18E+02
AVERAGE TIME FROM SLAUGHTER OF MEAT ANIMAL TO CONSUMPTION (DAY)	0.20E+02
FRACTION OF PRODUCE INGESTED GROWN IN GARDEN OF INTEREST	0.10E+01
FRACTION OF LEAFY VEGETABLES GROWN IN GARDEN OF INTEREST	0.10E+01
PERIOD OF LONG-TERM BUILDUP FOR ACTIVITY IN SOIL (YEARS)	0.10E+03
EFFECTIVE SURFACE DENSITY OF SOILKG/SQ. M, DRY WEIGHT. (ASSUMES 15 CM PLOW LAYER)	0.22E+03
VEGETABLE INGESTION RATIO-IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	0.76E-01

MEAT INGESTION RATIO-IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	0.30E-00
MILK INGESTION RATIO-IMMEDIATE SURROUNDING AREA/TOTAL WITHIN AREA	0.00E+00
MINIMUM FRACTIONS OF FOOD TYPES FROM OUTSIDE AREA LISTED BELOW ARE ACTUAL FIXED VALUES	
MINIMUM FRACTION VEGETABLES INGESTED FROM OUTSIDE AREA	0.00E+00
MINIMUM FRACTION MEAT INGESTED FROM OUTSIDE AREA	0.00E+00
MINIMUM FRACTION MILK INGESTED FROM OUTSIDE AREA	0.00E+00
INHALATION RATE OF MAN (CUBIC CENTIMETERS/HR)	0.92E+06
BUILDUP TIME FOR RADIONUCLIDES DEPOSITED ON GROUND AND WATER (DAYS)	0.37E+05
DILUTION FACTOR FOR WATER FOR SWIMMING (CM)	0.10E+01
FRACTION OF TIME SPENT SWIMMING	0.00E+00
MUSCLE MASS OF ANIMAL AT SLAUGHTER (KG)	0.20E+03
FRACTION OF ANIMAL HERD SLAUGHTERED PER DAY	0.3[illegible]E-02
MILK PRODUCTION OF COW (LITERS/DAY)	0.11E+02
FALLOUT INTERCEPTION FRACTION-VEGETABLES	0.20E+00
FALLOUT INTERCEPTION FRACTION-PASTURE	0.57E+00
FRACTION OF RADIOACTIVITY RETAINED ON LEAFY VEGETABLES AND PRODUCE AFTER WASHING	0.50E+00

DATE Thu 29 November, 1990 7:37:49 PM

COMPUTED VALUES FOR THE AREA

TOTAL POPULATION	64.0
TOTAL NUMBER OF MEAT ANIMALS	256
TOTAL NUMBER OF MILK CATTLE	128
TOTAL AREA OF VEGETABLE FOOD CROPS (SQUARE METERS)	0.64E+06
TOTAL MEAT CONSUMPTION (KG PER YEAR)	0.54E+04
TOTAL MEAT PRODUCTION (KG PER YEAR)	0.71E+05
TOTAL MILK CONSUMPTION (LITERS/YEAR)	0.72E+04
TOTAL MILK PRODUCTION (LITERS/YEAR)	0.51E+06
TOTAL VEGETABLE FOOD CONSUMPTION (KG PER YEAR)	0.12E+05
TOTAL VEGETABLE FOOD PRODUCED (KG PER YEAR)	0.46E+06

DATE Thu 29 November, 1990 [illegible]

*LIST OF INPUT DATA FOR NUCLIDE RN-222 *

RADIOACTIVE DECAY CONSTANT (PER DAY)	0.18E+00
ENVIRONMENTAL DECAY CONSTANT--SURFACE (PER DAY)	0.55E-04
ENVIRONMENTAL DECAY CONSTANT--WATER (PER DAY)	0.00E+00
AVERAGE FRACTION OF ANIMAL'S DAILY INTAKE OF NUCLIDE WHICH APPEARS IN EACH L OF MILK (DAYS/L)	0.00E+00
FRACTION OF ANIMAL'S DAILY INTAKE OF NUCLIDE WHICH APPEARS IN EACH KG OF FLESH (DAYS/KG)	0.00E+00
CONCENTRATION FACTOR FOR UPTAKE OF NUCLIDE FROM SOIL FOR PASTURE AND FORAGE (IN PCI/KG DRY WEIGHT PER PCI/KG DRY SOIL)	0.00E+00
CONCENTRATION FACTOR FOR UPTAKE OF NUCLIDE FROM SOIL BY EDIBLE PARTS OF CROPS (IN PCI/KG WET WEIGHT PER PCI/KG DRY SOIL)	0.00E+00
GI UPTAKE FRACTION (INHALATION)	0.00E+00
GI UPTAKE FRACTION (INGESTION)	0.00E+00
PARTICLE SIZE (MICRONS)	0.00E+00
SOLUBILITY CLASS	*

EXPOSURE LEVELS FOR SHORT-LIFE PROGENY OF RN-222
AT VARIOUS LOCATIONS IN THE ENVIRONMENT

AREA WIND TOWARD	DISTANCE (METERS)	EXPOSURE LEVEL(.7 EQF) (PERSON .WL)	ADJUSTED EQUIL. FRACT.	ADJUSTED EXPOSURE LEVELS
N	150	9.1E-07	0.27	3.5E-07
N	183	8.2E-07	0.27	3.2E-07
N	300	5.2E-07	0.28	2.1E-07
N	545	2.7E-07	0.29	1.1E-07
NNW	150	5.6E-07	0.27	2.1E-07
NNW	183	5.0E-07	0.27	1.9E-07
NNW	300	3.1E-07	0.28	1.2E-07
NNW	545	1.5E-07	0.29	6.4E-08
NW	150	7.0E-07	0.27	2.7E-07
NW	183	6.3E-07	0.27	2.4E-07
NW	300	4.0E-07	0.28	1.6E-07
NW	545	2.1E-07	0.29	8.8E-08
WNW	150	3.2E-07	0.27	1.2E-07
WNW	183	2.9E-07	0.27	1.1E-07
WNW	300	1.8E-07	0.28	7.1E-08
WNW	545	8.9E-08	0.29	3.7E-08
W	150	4.5E-07	0.27	1.7E-07
	183	4.1E-07	0.27	1.6E-07
	300	2.6E-07	0.28	1.0E-07
W	545	1.4E-07	0.29	5.7E-08
WSW	150	4.1E-07	0.27	1.6E-07
WSW	183	3.7E-07	0.27	1.4E-07
WSW	300	2.3E-07	0.28	9.1E-08
WSW	545	1.1E-07	0.29	4.7E-08
SW	150	5.7E-07	0.27	2.2E-07
SW	183	5.2E-07	0.27	2.0E-07
SW	300	3.3E-07	0.28	1.3E-07
SW	545	1.8E-07	0.29	7.4E-08
SSW	150	3.8E-07	0.27	1.5E-07
SSW	183	3.5E-07	0.27	1.3E-07
SSW	300	2.2E-07	0.28	8.3E-08
SSW	545	1.2E-07	0.29	4.8E-08
S	150	5.2E-07	0.27	2.0E-07
S	183	4.7E-07	0.27	1.8E-07
S	300	3.0E-07	0.28	1.2E-07
S	545	1.6E-07	0.29	6.4E-08
SSE	150	5.7E-07	0.27	2.2E-07
SSE	183	5.0E-07	0.27	2.0E-07
SSE	300	3.1E-07	0.28	1.2E-07
SSE	545	1.4E-07	0.29	6.0E-08
SE	150	1.1E-06	0.27	4.1E-07
SE	183	9.4E-07	0.27	3.6E-07
	300	5.5E-07	0.28	2.2E-07
	545	2.5E-07	0.29	1.0E-07
ESE	150	9.0E-07	0.27	3.4E-07
ESE	183	7.9E-07	0.27	3.1E-07
ESE	300	4.6E-07	0.28	1.8E-07

ESE	545	2.0E-07	0.29	8.3E-08
E	150	1.0E-06	0.27	4.0E-07
E	183	9.3E-07	0.27	3.6E-07
E	300	5.6E-07	0.28	2.2E-07
E	545	2.6E-07	0.29	1.1E-07
ENE	150	1.3E-06	0.27	4.9E-07
ENE	183	1.1E-06	0.27	4.3E-07
ENE	300	6.6E-07	0.28	2.6E-07
ENE	545	3.0E-07	0.29	1.3E-07
[redacted]	[redacted]	1.6E-06	0.27	[redacted]
NE	183	1.4E-06	0.27	5.4E-07
NE	300	8.4E-07	0.28	3.3E-07
NE	545	4.0E-07	0.29	1.7E-07
NNE	150	9.3E-07	0.27	3.5E-07
NNE	183	8.2E-07	0.27	3.2E-07
NNE	300	5.0E-07	0.28	2.0E-07
NNE	545	2.4E-07	0.29	1.0E-07